

Guidelines on Medical Surveillance for Health Care Workers

to work as Inside Attendant of a Multiplace Hyperbaric Chamber

Introduction:

The development on the field of hyperbaric medicine in Hong Kong is in its infancy. Although regulations for medical surveillance of occupational divers working in compressed air exist, medical surveillance guidelines which are specific for inside attendants (IA) attending patients who receive Hyperbaric Oxygen Therapy (HBOT) inside a multiplace hyperbaric chamber are absent.¹ The working environment and job nature for an IA in a multiplace hyperbaric chamber differs significantly from that of a tunnel worker for example. As such, the occupational risks which they are facing are different in types and severity; and therefore, the medical fitness requirement may not be the same.² Hyperbaric Associations of Australia, Canada, Europe and United States of American have provided standards on fitness to work as IA for use in their respective countries.^{3,4} With reference to these standards, the Hyperbaric Medicine Subcommittee of the Hong Kong College of Emergency Medicine (HKCEM) issued this medical surveillance guidelines for Hong Kong. This helps to minimize occupational risks to local IAs for hyperbaric treatment inside multiplace hyperbaric chamber.

Objectives:

The objectives of this document are:

1. To set standard on medical surveillance for IAs of multiplace hyperbaric chamber,
2. To provide a template for qualified medical practitioners to use when evaluating medical fitness of a candidate before commencing the work as IA in a multiplace hyperbaric chamber.

This standard set does not replace or supersede any local or institutional standard. In addition, this paper focuses on medical fitness for pressurization and does not cover other requirements for the job of an IA e.g., patient lifting.

The medical surveillance guidelines for health care worker (HCW) to work as IA in a multiplace hyperbaric chamber were formulated based on the following documents:

- Undersea and Hyperbaric Medical Society (UHMS) Medical Fitness to Work Guidelines for Multiplace Inside Attendants 1st edition. Undersea Hyperb Med. 2018 Mar-Apr;45(2):231-247. PMID: 29734576.
- Australian/New Zealand Standard. Work in compressed air and hyperbaric facilities Part 2: Hyperbaric Oxygen Facilities (AS/NZS 4774.2:2019)
- Fitness to Return to Diving after Decompression Illness. DMAC 13 Rev. 3 – December 2022.

Recommendations

1. Who to perform the medical surveillance?

The medical surveillance should be performed by fully registered medical practitioners (MBBS or MBChB or equivalent) with proper training in hyperbaric and diving medicine and with hyperbaric medicine experience. The medical practitioners should be familiar with this guideline and should be capable of exercising good judgement in determining fitness to work

in a multiplace hyperbaric chamber. Advice of a hyperbaric specialist may be sought in case the medical fitness of a candidate is in doubt. Hyperbaric specialists are medical professionals who have completed formal training in occupational diver medicals and have relevant experience in hyperbaric units formally recognized by the HBOT centers under the Hospital Authority or by the Occupational Medicine Division of the Labour Department.

2. What are the occupational risks?

Majority of the medical incidents are barotrauma to ear or sinus with incidence of about 173 per 100,000 treatment sessions.⁵ Risk of decompression illness ranged from 0-372 per 100,000 sessions.⁶ Medical incidents occurring among IAs are low. However, when occurred, the incident should be properly documented and reported to Occupational Medicine Division of the Labour Department.

3. When should the medical surveillance be performed and what should be included?

In general, a high standard of physical and mental health is required for staff working as IA in the hyperbaric chamber. It is noteworthy that although majority of the excluding conditions listed in the medical questionnaire are chronic, a temporary medical illness could also affect the safety of staff and those in their care. Details of the recommended pre-employment tests and the respective periodicity are shown on annex 1.

The medical surveillance includes two parts

- I. Medical Questionnaire (Annex 2) and
- II. Physical Examination form (Annex 3)

4. When should the medical surveillance be performed and when to repeat?

To qualify HCWs to work as IA, the following are recommended:

- I. A full pre-employment medical surveillance
- II. A Self-reporting Medical Questionnaire per annum
- III. Periodic physical examinations as indicated in Annex 1
- IV. A full medical surveillance (both Self-reporting Medical Questionnaire and Physical Examination) after a hyperbaric related injury or illness such as decompression sickness (DCS), arterial gas embolism, audio-vestibular illness, central nervous system diseases, or when there is a change on the annual self-report (point II above)
- V. Medical Questionnaire should be performed again and reviewed prior to return to hyperbaric exposure after any significant injury or illness.
- VI. IAs may not be allowed to return to work in hyperbaric conditions after any significant injury or illness if determined to be unfit by a hyperbaric specialist
- VII. There is not enough evidence to support periodic x-ray screening for IA. Given the controlled environment inside hyperbaric chamber and the risks of radiation, yearly x-ray screening of the IA for e.g., dysbaric osteonecrosis or related conditions is not recommended^{7,8,9,10}, and radiological imaging should only be performed when medically indicated³.

5. What are the disqualifying conditions?

IA having any of the following conditions should be disqualified from working inside hyperbaric chamber as IA.

- I. Seizure disorder (other than childhood febrile seizures)
- II. Bullous, cystic or cavitary lung disease, significant obstructive or restrictive lung disease, recurrent pneumothorax
- III. Significant central or peripheral nervous system disease or impairment
- IV. Chronic alcoholism or history of drug abuse
- V. History of psychosis
- VI. Hemoglobinopathies associated with comorbidities
- VII. Requirement for oxygen at sea level
- VIII. Grossly impaired hearing
- IX. Significant osteonecrosis
- X. Current pregnancy
- XI. Chronic inability to equalize sinus or middle ear pressure
- XII. Chronic medical illness with suboptimal control

6. What should be done for the staff following an injury or illness?

Staff sustaining or affected by any of the following injury or illness should not return to work as IA until re-examined and cleared by a hyperbaric specialist. The hyperbaric specialist shall determine the scope of the re-examination based on the nature of the injury or illness included

- i. A pressure/ hyperbaric related injury or illness requiring medical attention,
- ii. Decompression illness or arterial gas embolism,
- iii. Audio-vestibular illness, or
- iv. Diseases of the central nervous system

7. When could the injured staff return to work as IA after suffering from decompression sickness?

Although the risk of decompression sickness among IAs is inherently very low, the risk still exists. The following guidance provides the recommended minimum time intervals for return to work as IAs after suffering from different forms of decompression illness. In some cases, longer intervals may be appropriate or necessary in order to complete the investigations required. The recommended minimum time interval begins after completion of successful treatment. Staff suffered from

- I. DCS Type I may return to work as IA 7 days after treatment finished with complete symptomatic resolution and cleared by a hyperbaric specialist.
- II. DCS Type II may return to work as IA 30 days after treatment finished with complete symptomatic resolution and cleared by a hyperbaric specialist.
- III. Gas embolism or persistent neurologic deficits are disqualifying to work as IA.

8. Any exemptions to a full medical surveillance?

Under special circumstances or in situations which could not be foreseen, HCWs from other departments or accompanying person(s) of a patient may be required to enter hyperbaric chamber with the patient for HBOT. Common examples include HCWs of intensive care units who do not have in-chamber experience, or parents of paediatric patients requiring HBOT. In such cases, a hyperbaric specialist shall conduct the shortened medical assessment for the accompanying person(s).

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Reference

- ¹ FACTORIES AND INDUSTRIAL UNDERTAKINGS (WORK IN COMPRESSED AIR) REGULATIONS (Cap. 59 sub. leg. M)
- ² Pougnet R, Pougnet L, Lucas D, Henckes A, Loddé B, Dewitte JD. Health effects of hyperbaric exposure on chamber attendants: a literature review. *Int Marit Health*. 2018;69(1):58-62. doi: 10.5603/IMH.2018.0009. PMID: 29611615.
- ³ UHMS Medical Fitness to Work Guidelines for Multiplace Inside Attendants 1st edition. *Undersea Hyperb Med*. 2018 Mar-Apr;45(2):231-247. PMID: 29734576.
- ⁴ Australian/New Zealand Standard™. *Work in compressed air and hyperbaric facilities Part 2: Hyperbaric Oxygen Facilities (AS/NZS 4774.2:2019)*
- ⁵ Pougnet R, Henckes A, Pougnet L, Cochard G, Dantec F, Dewitte JD, Loddé B. Occupational accidents among attendants inside hyperbaric chambers in France. *Med Lav*. 2015 Jan 9;106(1):17-22. PMID: 25607284.
- ⁶ Pougnet R, Pougnet L, Lucas D, Henckes A, Loddé B, Dewitte JD. Health effects of hyperbaric exposure on chamber attendants: a literature review. *Int Marit Health*. 2018;69(1):58-62. doi: 10.5603/IMH.2018.0009. PMID: 29611615.
- ⁷ Cooper PD, Van den Broek C, Smart DR. Hyperbaric chamber attendant safety II: 14-year health review of multiplace chamber attendants. *Diving Hyperb Med*. 2009 Jun;39(2):71-6. PMID: 22753199.
- ⁸ Uguen M, Pougnet R, Uguen A, Loddé B, Dewitte JD. Dysbaric osteonecrosis among professional divers: a literature review. *Undersea Hyperb Med*. 2014 Nov-Dec;41(6):579-87. PMID: 25562949.
- ⁹ Sharareh B, Schwarzkopf R. Dysbaric osteonecrosis: a literature review of pathophysiology, clinical presentation, and management. *Clin J Sport Med*. 2015 Mar;25(2):153-61. doi: 10.1097/JSM.0000000000000093. PMID: 24662571.
- ¹⁰ Pougnet R, Pougnet L, Lucas D, Henckes A, Loddé B, Dewitte JD. Health effects of hyperbaric exposure on chamber attendants: a literature review. *Int Marit Health*. 2018;69(1):58-62. doi: 10.5603/IMH.2018.0009. PMID: 29611615.

Annex 1: Pre-employment medical tests and periodicity of respective tests for HCWs to work inside multiplace hyperbaric chambers by the UHMS

Pre-employment tests	Periodicity after employment	Remarks
Medical Questionnaire	Annually	
Physical examination	Every 5 years or when deemed necessary	
Test dive (to 2 ATA)	As when clinically indicated	
Pulmonary function	As clinically indicated. At least every 5 years for smokers or history of chronic respiratory illness.	FEV1, FVC, PEF, FEF25-75.
Audiometry	As when clinically indicated	Pure tone audiology
Urinalysis	As when clinically indicated	
Complete blood picture	As when clinically indicated	
Chest x-ray	As when clinically indicated	PA (Inspiratory and expiratory)
12 lead ECG	As when clinically indicated	
Visual acuity	As when clinically indicated	Vision, near & distant, uncorrected and corrected, to include color
** Additional tests at the discretion of medical practitioner or in case of abnormal result		

ATA – Atmospheric absolute; FEV1 – First second of forced expiration; FVC – Forced vital capacity; PEF – Peak expiratory flow; FEF25-75 – Forced mid expiratory flow; PA – Posterior anterior; ECG - electrocardiograph

HKCEM HBO subcommittee Medical surveillance forms (Annex 2 and 3)**Annex 2 - Medical Questionnaire**

Surname		Given names	
Date of birth		Sex	
Phone	Mobile	Work	
Emergency contact person	Name	Relationship	contact numbers
Mailing address			
Occupation			

Please circle and provide relevant details

Medical examination – Medical Questionnaire	Doctor's use only
1. Sports activity – Type, Frequency (rarely, <1/w, weekly, 2-3/w, most days)	
2. Smoker Yes/ No / ex-smoker	
3. Alcohol Y/N, Yes - How many drinks per week on average No	
4. Are you taking any tablets, medicines or drugs? List medications taking if yes	
5. Do you have any allergies? Details if yes	
6. Have you ever had any reactions to drugs, medicines or foods? Details if yes	
7. Previous diving or hyperbaric medical exam Yes/ No	
8. Prescription spectacles Yes/ No	
9. Contact lenses Yes/ No	
10. Eye or visual problems Yes/ No	
11. Eye operation Yes/ No	
12. Dentures or plate Yes/ No	
13. Recent dental procedure Yes/ No	
14. Allergic rhinitis Yes/ No	
15. Hay fever Yes/ No	
16. Sinusitis Yes/ No	
17. Nosebleeds Yes/ No	
18. Deafness or ringing noises in the ear Yes/ No	
19. Ear infections or discharge from the ear Yes/ No	
20. Giddiness or loss of balance or vertigo Yes/ No	
21. Ear operation Yes/ No	
22. Other ear, nose or throat problem Yes/ No	
23. Problems with ears or sinuses when flying in aircraft Yes/ No	

24. Severe or frequent headaches	Yes/ No	
25. Migraine	Yes/ No	
26. Fainting or blackouts	Yes/ No	
27. Convulsions, fits or epilepsy	Yes/ No	
28. Stroke/ Transient ischaemic attack	Yes/ No	
29. Unconsciousness	Yes/ No	
30. Head injury or concussion	Yes/ No	
31. Depression/ Anxiety/ Mood problem	Yes/ No	
32. Claustrophobia	Yes/ No	
33. Mental illness	Yes/ No	
34. Chest pain or discomfort on exertion	Yes/ No	
35. Shortness of breath on exertion		
36. Palpitations or consciousness of heartbeat	Yes/ No	
37. Heart disease	Yes/ No	
38. High blood pressure	Yes/ No	
39. Rheumatic fever	Yes/ No	
40. Abnormal ECG	Yes/ No	
41. Abnormal blood test(s)	Yes/ No	
42. Bronchitis or pneumonia	Yes/ No	
43. Pleurisy or chest wall pain	Yes/ No	
44. Coughing up blood or phlegm	Yes/ No	
45. Chronic or persistent cough	Yes/ No	
46. Pneumothorax	Yes/ No	
47. TB	Yes/ No	
48. Bronchitis or pneumonia	Yes/ No	
49. Frequent colds or flu	Yes/ No	
50. Asthma or wheezing	Yes/ No	
51. Need to use a puffer or inhaler	Yes/ No	
52. Operation on chest, lungs or heart	Yes/ No	
53. Any other chest complaints	Yes/ No	
54. Indigestion, acid reflux or peptic diseases	Yes/ No	
55. Vomiting blood or passing red or black bowel motions	Yes/ No	
56. Recurrent vomiting or diarrhoea	Yes/ No	
57. Jaundice, hepatitis or liver disease	Yes/ No	
58. Malaria or other tropical disease	Yes/ No	
59. Severe loss of weight	Yes/ No	
60. Hernia	Yes/ No	
61. Back injury	Yes/ No	
62. Significant joint problem or sports injury	Yes/ No	
63. Limitation of movement	Yes/ No	
64. Fracture	Yes/ No	
65. Paralysis or muscle weakness	Yes/ No	
66. Kidney or bladder diseases	Yes/ No	
67. Diabetes	Yes/ No	
68. Thalassaemia/ Sickle cell disease	Yes/ No	

69. Bleeding problem or other blood disease	Yes/ No	
70. Skin disease	Yes/ No	
71. Contagious disease	Yes/ No	
72. Operations	List of operation(s) if yes	
73. Admitted to hospital	Discharge diagnosis if yes	
74. Rejected for life insurance	Yes/ No	
75. Any history of injuries or accidents or illnesses from work	Details if yes	
76. Failed a medical examination	Yes/ No	
77. Unable to work on medical grounds	Yes/ No	
78. Any other illness or health problem	Yes/ No	
79. Family history of heart disease	Yes/ No	
80. Family history of asthma or chest disease	Yes/ No	
<u>For female only</u>		
81. Are you now pregnant or planning to become pregnant	Yes/ No	
<u>Diving/ compression history to date</u>		
82. Approx. date of first compressed air exposure		
83. Total hours under pressure		
84. Types of diving experience (SCUBA air, SCUBA mixed gas, hookah, Bell diving, Surface supply, Surface deco, Saturation, Oxygen)		
85. Types of hyperbaric therapy experience (routine patients, emergency patients, decompression illness patients, Hyperbaric chamber attendant)		
86. How many compressions to date? (longest table, highest pressure)		
87. Have you ever suffered from (ear squeeze, sinus squeeze, decompression illness, headaches during or after dive, extreme tiredness after dive)		
88. Any other diving-related problems?	Yes/ No	

Signed: _____ Candidate: _____ Date: _____

Annex 3 – Physical Examination Form

General comments				
Height	cm	Weight	kg	BMI
Visual acuity	Uncorrected	Corrected	Near vision	
Right	6/	6/		
Left	6/	6/		
BP	/	Pulse	/min	
Ophthalmoscopy		Normal	Abnormal	
Pupils		Normal	Abnormal	
Eye movements		Normal	Abnormal	
Visual fields		Normal	Abnormal	
Colour vision		Normal	Abnormal	
Head, scalp, face, neck		Normal	Abnormal	
Nose, septum, airway, sinuses		Normal	Abnormal	
Mouth, throat, teeth, speech		Normal	Abnormal	
External ears		Normal	Abnormal	
Tympanic membrane R		Normal	Abnormal	
L		Normal	Abnormal	
Eustachian tubes R		Easily with Valsalva	With difficulty	Unsatisfactory
L		Easily with Valsalva	With difficulty	Unsatisfactory
Chest and lung fields		Normal	Abnormal	
Heart sounds		Normal	Abnormal	
Abdomen		Normal	Abnormal	
Lymph nodes		Normal	Abnormal	
Posture and gait		Normal	Abnormal	
Spine		Normal	Abnormal	
Upper limbs		Normal	Abnormal	
Lower limbs		Normal	Abnormal	
Tendon reflexes				
Biceps R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Triceps R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Brachioradialis R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Knee R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Ankle R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Plantar R		Weak	Mid-range	Brisk
L		Weak	Mid-range	Brisk
Sensation		Normal	Abnormal	
Cerebellar functions		Normal	Abnormal	
Sharpened Romberg test				
Longest period sustained up to 60s (max 3 attempts)				
Emotional and psychiatric stability		Normal	Abnormal	Pending
Chest X-ray		Normal	Abnormal	Pending

12-lead ECG	Normal			Abnormal				
Pulmonary function	Normal			Abnormal				
Audiometry	Normal			Abnormal			Pending	
Hearing level (Hz)	500	1000	1500	2000	3000	4000	6000	8000
dB (R)								
dB (L)								
Tympanometry	Normal			Abnormal				
Urinalysis	Normal			Abnormal				
Complete blood picture	Normal			Abnormal				
Other tests	Nil required			Indicated (specify)				
Other abnormalities found	No			Yes (specify)				
Medical fitness recommendation								
- Fit to undertake hyperbaric attendance								
- Unfit to undertake hyperbaric attendance due to:								
- Fitness status pending due to:								
Comments:								
Signed:								
Candidate name (print):								
Doctor's name (print):								
Date:								